CAR DRIVER ASSISTED FOR BLIND SPOT DETECTION SYSTEM

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ABSTRACT

Car Driver Assisted for Blind Spot System is invented to observe the blind spot region and alert the driver automatically to ensure the driver safety on highway due to the driver inability to observe the blind spot area directly which had caused many accident occur. Eventually, the system is built from a combination of a circuit and programming software of microcontroller and ultrasonic sensor. In this project, 2 ultrasonic sensors will be put at the right side of a car because the risk of danger in the blind spot is higher at the driver side. The sensors will be put on the lateral side of the front and rear side of a car to check the incoming vehicle at the blind spot. The sensors will be activated at a certain speed and when both sensors detect a vehicle at the blind spot, a warning system will trigger. An indicator light or LED located at the side mirror will be used as visual warning system while a buzzer will be used as audio warning system which can be install inside the car. Hence, the system will help a driver to drive safely and prevent any fatal accident involving blind spot. As the result, the statistic for accident can be lower.

ABSTRAK

Sistem Bantuan Pemandu Kereta di Titik Buta dicipta untuk memantau titik buta dan memberi amaran kepada pemandu secara automatik untuk memastikan keselamatan pemandu di lebuh raya kerana ketidakupayaan pemandu untuk meninjau kawasan tersebut secara langsung telah menyebabkan banyaknya berlaku kemalangan. Sistem ini dibina daripada gabungan perisian dan pengaturcaraan litar mikropengawal dan sensor ultrasonik. Dalam projek ini, 2 sensor ultrasonik akan diletakkan disebelah kanan kereta kerana risiko bahaya titik buta adalah lebih tinggi di sebelah pemandu. Sensor akan diletakkan di sebelah sisi bahagian depan dan belakang sebuah kereta untuk memeriksa kenderaan yang masuk pada titik buta. Sensor akan diaktifkan pada kelajuan tertentu dan apabila kedua-dua sensor mengesan kenderaan di titik buta, satu sistem amaran akan dicetuskan. Satu lampu penunjuk atau LED yang terletak di cermin sisi akan digunakan sebagai sistem amaran visual manakala pembaz akan digunakan sebagai sistem amaran audio yang boleh dipasang dalam kereta. Oleh itu, sistem akan dapat membantu pemandu untuk memandu dengan selamat dan mencegah apa-apa kemalangan maut yang melibatkan tempat buta. Hasilnya, statistik kemalangan boleh direndahkan.

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LIST OF SYMBOL

°	Degree
Ω	Ohm
≤	Less And Equal Than
≥	Greater And Equal Than
=	Equal
F	Farad
μ	Micro
p	Pico
mm	Milimeter
kmph	Kilometer Per Hour
k	Kilo
M	Mega
m	Meter

LIST OFABBREVIATIONS

PIC	Peripheral Interface Controller
VDC	Voltage Direct Current
GND	Ground
US	ultrasonic sensor
LCD	Liquid Crystal Display
LED	Light Emitting Diode
PCB	Printed Circuit Board
TX	transmitting signal
RX	receiving signal
VSM	Virtual System Modelling
BSD	Blind Spot Detection System
MCU	Microcontroller
USB	Universal Serial Bus
A/D	Analog to Digital Converter
IR	Infra-Red
USART	Universal Asynchronous Receiver Transmitter
RISC	Reduced Instruction Set Computing
BLIS	Blind Spot Information System
CPS	Car Periphery Supervision System
SPICE	Simulation Program with Integrated Circuit Emphasis

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CHAPTER 1

INTRODUCTION

1.0 OVERVIEW

Nowadays, car driver assisted technology had been develop widely by car manufacturer like Mercedes, Volvo and Lexus. The purpose for this technology is assisting a driver while driving to ensure the driver safety.by reducing driver mistakes. For example, the car driver assisted technology that had been released into the market is Lexus Advanced Pre-Collision System, Mercedes Distronic Plus with PreSafe Brake, and BMW Active Cruise Control with Stop & Go which serve difference aspect of safety. Thus, many buyers will consider this technology before buying a car.

Moreover the technology is design to be automated monitoring to increase the system reliability compare to the old method such as blind spot mirror to observe the blind spot area that requires driver observation to interpret the image, thus theirs efficiency is depend on driver. By using this technology, driver mistakes while driving will be eliminated thus, the safety of the driver and the others road user can be guaranteed.

In the nutshell, as a developing country Malaysia had to compete in world market to create a Malaysian brand car driver assisted technology. Consequently, the price of local car equipped with this technology will be cheaper than imported car that can be incurred by Malaysian citizen. In addition, the technology still can be developing for more application or variety aspect of safety.

1.2 Blind Spot

Blind spot region is an area to the side and slightly behind driver fields of vision that is not reflected in the vehicle rear mirror and requires the driver to turn their head slightly to monitor the area before making any action such as changing the lane. A problem will be occurs when a vehicle approaching another vehicle blind spot and the driver unable to see the vehicle decide to change the lane. For example, refer picture in Figure 1.1 below, location of cars on the road and the driver's view from side mirror and rear mirror was shown. At the right side, the blue car is in the green car blind spot area and drivers are able to see a little bit part of the blue car and assume the location of the car is far behind from his car. Then, when the green car decides to change the lane, accident may happen.

In addition, many road accident are occurs in blind spot region especially in highway due to overtaking, being overtake or changing the lane action. Sometimes, some drivers are too focusing to monitor their blind spot region and loss focus on the road in front of them. Those actions may lead them into accidents that contribute into injury, loss and even death. The consequence of the accident will bring misfortune to any involving party.

Awareness from the problem, many gadgets had been invented to monitor the region such as blind spot mirror but it less effective as accident still occurs because the device accuracy is depends on the driver. Thus, a system that can detect vehicles presence in blind spot and alerting the driver had been invented to ensure the road user safety.

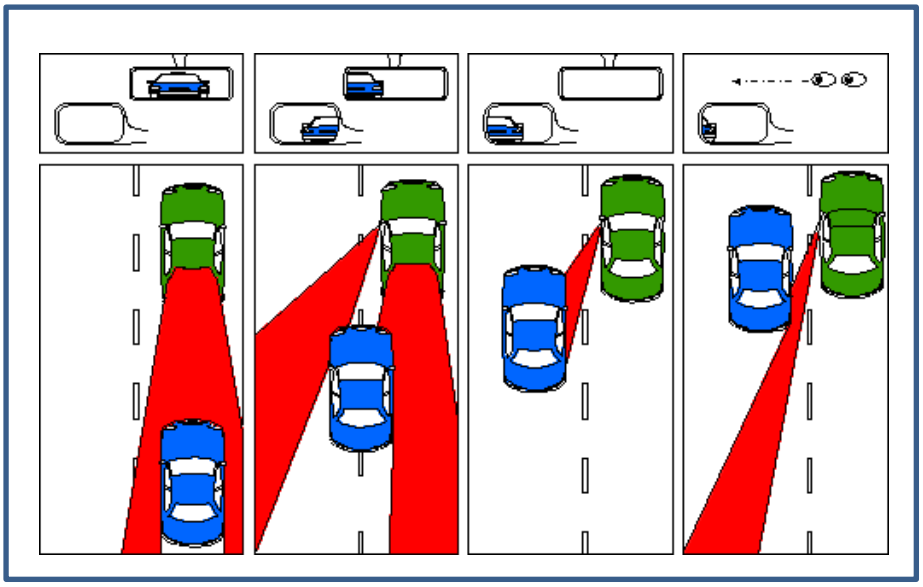

Figure 1.1 : Example of Blind Spot

1.3 OBJECTIVE

The objective of this project is:

i. To alert the driver when changing the lane or make a turn
ii. To ensure the driver safety while overtaking or being overtake
iii. To prevent fatal accident involving blind spot region

1.4 SCOPE OF PROJECT

The scope of the project is

i. To choose appropriate microcontroller and sensor for the system
ii. To describe how microcontroller can interface with ultrasonic sensor for the system
iii. To describe how ultrasonic sensor can detect vehicle on the blind spot region
iv. To determine the blind spot region of a vehicle

1.5 PROBLEM STATEMENT

Blind spot region is areas around a vehicle that cannot be observe directly by the driver, thus many road accidents occur because of the driver unable to see another vehicle approach the blind spot especially when changing the lane. Then, to overcome this problem a system that can detect the vehicle in the blind spot region should be invented to alert the driver about the situation on the blind spot region to ensure the safety of road users.

1.6 Thesis Outline

The Car Driver Assisted For Blind Spot System final thesis is combination of 5 chapter that contains and elaborates specific topics such as the Introduction, Literature Review, Result And Analysis and Conclusion. The detailed discussion about the thesis outline on each chapter is as below **:**

Chapter 1 : Introduction of the project. The explanation for the project will be given in a general term. The objectives of the project will be elaborated. It is followed by explanation in the scope of project.

Chapter 2 : Literature review for the development of blind spot system detection. This chapter describes the literature review of the project elaborately. Explanation will be focused on type of sensor related researched and based on theory and conceptual ideas. Some literature review of current existing projects based on BSD and hardware review of prototypes are also being discussed**.**

Chapter 3 : Methodology of the project. This chapter discusses the full methodology of the overall project along with hardware and software development**.**

Chapter 4 : Result and Analysis. This chapter explains the results obtained regarding the performance of the system**.**

Chapter 5: Discussion and Conclusion. In this chapter discussion, costing & commercialization and future recommendation had been discussed. Lastly, the conclusion of this project is also being discussed.

CHAPTER 2

LITERATURE REVIEW

2.0 Blind Spot

The blind spot of vehicle is the road area that is invisible to the driver viewpoint while looking through side-view or rear-view mirror [9] without head rotation [8] which can lead into accident. The spot will become most critical when the driver is changing lane. For example, a driver who is going to change lanes looks in the side mirror to confirm that the lane is free, but a car suddenly comes from behind, just when the driver is about to change lanes [9], thus accident will be happen if the driver ignore the blind spot area. Furthermore in Australia, there are large difference and increasing gap between cyclist and car occupant safety caused by cycling blind spot [8]. Hence, blind spot can increase the risk of accident.

Consequently, in Malaysia 6 position of collision had been identified which is collisions with vehicle in front or behind, while overtaking or being overtake, at crossroad and from opposite direction vehicle[7]. In fact, 2 of them are related to blind spot area which is while overtaking or being overtaken. Hence, from statistic OPS Sikap report, the number of accident in this country is high especially during special event such as Hari Raya or Chinese New Year and eventually the statistic can be reduce once the problem involving blind spot can be overcome.

In short, Car Driver Assisted For Blind Spot Detection System will be invented and installed in every car to overcome the blind spot problem. Thus, accident risk will be reduce along with accident statistic and develop a free accident road in this country.

2.1 Blind Spot Detection System

Awareness of the problem arise from the danger of vehicle blind spot to the road user, many car manufacturer, private company and university such as Volvo, Ford, Bosch, SCU and Zhejiang University had develop Blind Spot Detection System or BSD using a different method from each other. On the contrary, theirs approach are almost the same which is to detect a vehicle presence in blind spot area and alert the driver.

In 2009, Ford has develop and install BLIS or Blind Spot Information System with cross-traffic alert into 2010 Ford Fusion and Fusion Hybrid. The system is design to detect vehicles in blind spot during normal driving and traffic approach from the sides when reversing out of parking spots [13]. The features uses for the system are 2 multiple-beam radar modules which is the same used with cross-traffic alert that are packaged in the rear quarter panel [13]. The radar will identifies when a vehicles enters the defined blind spot zone and illuminates an indicator light on the corresponding side view mirror to provide a warning that a car a vehicle is approach.

Besides that, from the research of Anderson Darryll , CEO and Inventor of the "Vector" Blind Spot Detection System, he uses infrared sensor as the input of the system that can be removable attached at the rear mirror along with a LED as the output. The system is operated when the output power of the infrared transmitter is linearly modulated, enabling the blind spot detector to determine the proximity of the detected object [2]. During normal operation, an object is detected when the transmitted power is greater than a predetermined lower threshold and less than the calibration level will activate a LED indicator on the system housing [2].

On another hand, from the Bosch Group that specializes in producing component and system for automobiles report on initiative in applying product line development approach to develop Car Periphery Supervision System or CPS [1], where the system is built from combination of several sensors to do a multitask such as BSD, Car Parking Assistance, Pre- Crash Detection and Adaptive Cruise Stop & Go. In any case, their BSD system uses lateral front and rear sensors for detecting

passing vehicles [1], where the rear sensors observe the central blind spot region, whereas the front sensors discriminates irrelevant warnings [1].

In the meantime, Miguel Angelo Sotelo and Jose Barriga have done a research about vision- based system for blind spot detection in intelligent applications [11] where a camera is mounted in the lateral mirror of a car to visually detect cars that are located in blind spot. Then, the detection is carried out using computer vision techniques based on optical flow and double stage data clustering technique for robust vehicle detection [11]. Despite that, vision-based intelligent require large amount of memory to handle video streaming and image processing [9], thus FPGA implement of vision-based blind spot warning system was introduced. This method is done by using video frame, the information of the blind spot are turns into one dimensional information [9].

Nowadays, in Malaysia Blind Spot Detection System (BSD) had been installed in imported car such as Sedan 80, thus the car price will be higher due to the technologies and the tax. Hence, as a developing country Malaysia had to compete in world market to create a Malaysian brand of BSD and to be installed in every local car. Subsequently, the price of local car equipped with the system will be cheaper than imported car. Eventually, Car Driver Assisted For Blind Spot System to full filled the demand and to introduce another Malaysian product to the world.

2.2 Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals which are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes.

2.2.1 PIC

PIC or Peripheral Interface Controller is a family of microcontroller modified using Harvard architecture which physically separate storage and signal pathways for instructions and data by Microchip Technology. PICs are popular with both industrial developers and hobbyists alike due to their low cost, wide availability, large user base, extensive collection of application notes, availability of low cost or free development tools, and serial programming (and re-programming with flash memory) capability. The advantages of PIC is, small instruction set to learn, RISC (Reduced Instruction Set Computing) architecture, built in oscillator and in circuit debugging, PICkit is available.

2.2.2 PIC 16F877A

The PIC16F877A features is 256 bytes of EEPROM data memory, self-programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

2.3 Sensor

In this project, sensor is used to detect a car presence in the blind spot area to build automated monitoring system, thus the sensor must be selected wisely because every sensor has theirs pro and cons. For example, vision based sensor can be used to observe the blind spot effectively but under extreme weather or environmental problem such as darkness, the sensor cannot used very well. Besides that, for radar or Radio Detection and Ranging has minimum false alarm device, which sounds the alarm only when there was a relative movement between the vehicle and the object [7]. In addition, this type of sensor cannot distinguish between object of varying size

and position. While laser sensor release a thin beam of light that can be used to measured distance up to 100cm precision but is quite expensive and can be used only to detect object within a single plane [7].

On other hand, based on research paper done by Tarek Mohammad are discussing about using Infrared and Ultrasonic sensor for distance measurement. The paper states that Infrared sensor (IR) is cheaper in cost and faster in response time of than ultrasonic sensor (US) [4]. Besides that, IR sensor is using reflected light and depends on reflectance of surfaces properties while US sensor is using reflected waves which independent on reflectance of surfaces properties to estimates the distance from an object [4]. Then, the author compared both sensors using Phong Illumination Model Approach to determine their reflectance properties of the surfaces and calculation of a distance. From the result, the amplitude of US sensor is dependent on the distance and orientation of the obstacles relatives to the sensor and the output signal is independent on the surfaces color and smoothness. While, for the amplitude of IR sensor is dependent on the reflectivity of the object obstacle and slightly dependent on environmental condition, such as sunlight. On another hands, US sensor has slightly higher resolution than IR sensor especially for small distance measurement within theirs usable range [4]. Thus, US sensor is better than IR sensor for outdoor application.

2.3.1 Ultrasonic sensor

Ultrasonic sensor can be use as object detector easily, for example the case study done by L.S Guo, System Safety Detecting System with Ultrasonic Sensor for Agricultural Machine is discussing about how to apply US sensor to detect the position of the moving objects around agricultural machines and generate a warning system when an object is detected at closed distance with the machine.[3]. The system is using 2 fixed US sensors to detect any presence around the moving object [3]. In addition, based on research done by Johann Borenstein and Yoram Koren, ultrasonic sensor is the best choice to use for obstacle avoidance for mobile robot [10].

Furthermore, the article by Alessio Carullo and Marco Parvis, An Ultrasonic Sensor for Distance Measurement in Automotive Applications is discussing about on how US sensors had been applied in a smart for the distance measurement in the range of few centimeter to the few meter [5]. Besides that, in this paper the author describe a low-cost US distance meter that performs contactless measurement of the height from the ground of a vehicle body [5]. The distance measurement, D can be obtained using equation below [5] :

$$D=k \,.\, T_f \,.\, V_s$$

Where,

k = constant close to 0.5, depends on the sensor geometry

T_f = time of flight of an ultrasonic

V_s = velocity of sound in the air

The distance was measure at difference temperature to prove the ability of US sensor to self –adapt to the different environmental conditions [5].The sensor contains a noise measurement system and auto-change facility of the signal that is used to drive the transmitter thus, producing the best accuracy under different conditions.

In a nutshell, US sensor is a better sensor to be used for outdoor distance measurement or object detection because of its wide beam width properties and high resolution for distance measurement. Besides that, from above research, US sensor is able to detect an approaching object which can be applied in the Blind Spot Detection System. Furthermore, the characteristic of US sensor that can self –adapt to difference environment will ensure the Blind Spot Detection System is able to use even during in harsh weather in Malaysia.

2.3.2 MB1010 Ultrasonic Sensor

MB1010 LV-MaxSonar®-EZ1™ is a product of ultrasonic sensor manufacture by Maxbotix Inc is easy to interface with others component or system as the sensor has 3 different output pin which is analog pin, pulse width pin, bandwidth pin, transmit pin and receiver pin. Besides that, the sensor has zero dead zones as the sensor can measure object distance from 0 - 6.25m, stable range readings, small size

and low power demands. Thus, the sensor can be power up by battery along with the whole circuit and consume only a little space. Hence, the sensor is suitable to be used for Car Driver Assisted For Blind Spot Detection System.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This section is about project flow and proposed methodology uses. Figure 3.1 shows the flow chart of the system methodology.

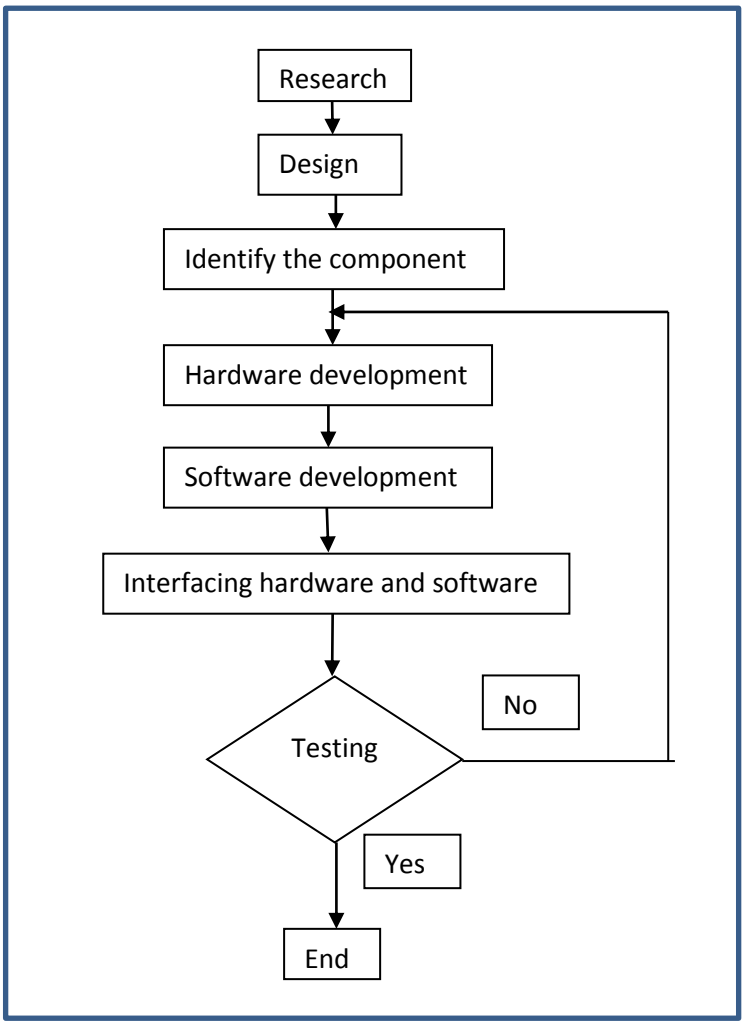

Figure 3.1: The flow chart of the methodology